Original Article

Results of uncemented distal locked prosthesis in revision hip arthroplasty with proximal femoral bone loss: A retrospective study

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Abstract

Introduction: Management of bone loss is a challenge in revision total hip arthroplasty (THA). A retrospective review was performed to study the use of uncemented distal locked prosthesis in cases with proximal femoral bone loss.

Materials and Methods: Uncemented stems with distal interlocking were used in 65 hips during revision THAs with 38 hips having Paprosky IIIB/IV defects between January 1998 and February 2004. There were 48 males and 17 females in the study with an average age of 53 years (range 30-80 years). Radiographic and clinical outcome evaluation using the Harris hip score (HHS) were performed.

Results: An improvement in HHS (mean: 33 points) was observed at final followup (mean: 9 years). Regeneration of proximal bone stock was observed without signs of loosening or subsidence and none of the stems were revised. Three patients developed recurrent dislocation while one had a stem subsidence of 1cm following removal of interlocking bolts.

Conclusion: Uncemented distal locked prosthesis provide adequate stability in revision THA, aiding the reconstruction of bony deficiencies while avoiding the disadvantages of fully porous or cemented implants.

Key words: Distal locked prosthesis, femoral bone loss, revision hip arthroplasty, uncemented revision total hip arthroplasty

Introduction

The commonest mechanism of failure of THA is aseptic loosening apart from other causes like periprosthetic fracture, stem fracture, infection, and recurrent dislocation.[1] Femoral revision is complicated by loss of the proximal femoral bone. The goal of revision is to obtain fixation of the revision implant and to reconstruct the proximal femoral bony deficiency.

The grade and type of the bony defects in the proximal femur are important determinants in preoperative planning and selection of implants. A variety of options regarding implant choice and method of fixation are available for revision THA.[2] The ideal surgical technique would aim to provide adequate stability while preserving and reconstructing deficient bone stock. It is also important that the implant helps to prevent further loss of bone.

A distal locked prosthesis has been shown to be successful in the revisions using the "reversed fixation principle." The distal locking provides initial stability necessary for the natural process of bone healing and osseointegration. After the reconstruction of proximal bone loss, the interlocking bolts are removed, thus transferring the load delivery back to the proximal femur, which is more physiological.[3]

We present our experience following use of a proximally coated distal locked prosthesis in revision hip arthroplasty at an average of 9 years postoperatively.

Materials and Methods

Between January 1998 and February 2004, 82 revision THAs were performed using the BiCONTACT revision stem (B.Braun-Aesculap, Tuttlingen, Germany) by four senior authors (SA, HRJ, JAP, SBJ) at two medical centers. All four surgeons were not always a part of the same operating team. The patient's data were recorded prior to

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surgery and at every followup. Of these, six patients died of unrelated causes and ten patients were lost to followup, one patient who underwent a 2-stage revision for infection was excluded. The remaining 65 patients were evaluated in February 2012 from the subject of the present study.

Patients who underwent revision of the femoral component with Bicontact interlocking stem for aseptic loosening or periprosthetic fracture of femur and were available for followup between January and February 2012 were included in the study. Patients who underwent surgery for infected revision, patients who were lost to followup or died were excluded. The implant used was an uncemented tapered proximally plasma sprayed stem with a facility for two distal interlocking bolts, of which the most distal slot allows dynamization. All the patients were informed preoperatively regarding the type of implant, which they would receive. A written informed consent was obtained. They were also informed that the data regarding their treatment would be submitted for publication and an approval for data collection was obtained from the institutional review board. All patients were reviewed annually and the final followup was in 2012. A total of 66 patients attended followup; 65 of these were included in the study and one patient who had a 2-stage revision for sepsis was excluded.

There were 48 males and 17 females in the study with an average age of 53 years (range 30-80 years). Forty four cases with both component loosening had both femoral and acetabular revision. Fifty-six cases had aseptic loosening, whereas nine cases had a periprosthetic fracture. Six cases had a Vancouver type B3 fracture and three cases had a type B2 fracture.[4]

In 40 cases, the primary component was cemented and uncemented in 25 cases. Patients with isolated femoral component loosening (n = 12) or periprosthetic femur fracture (n = 9) had femoral revision only while those with both femoral and acetabular loosening (n = 44) had both femoral and acetabular revision. In four cases, well-fixed acetabulum had to be removed to change version and address intraoperative instability. The proximal femoral bone loss was graded using the Paprosky classification.[5] There were 10 cases with grade II Paprosky defects, 18 cases with grade IIIA defects, 26 cases with grade IIIB defects [Figure 1], and 12 cases with grade IV defects [Figure 2].

Operative procedure

The lateral position was used in all the patients. Fifty five hips were operated by posterior approach while 11 by anterolateral approach.

In 13 cases, the implant along with the entire cement mantle could be extracted from the proximal femur without any need for an osteotomy; 25 cases required a transfemoral approach for implant removal. In 27 cases, a ventral cortical window was sufficient.[6] Prophylactic cerclage wiring just distal to the osteotomy was used to prevent splintering at the time of the insertion of the prosthesis. The distal femur was gently reamed with a hand reamer to preserve bone. A BiCONTACT stem (B.Braun-Aesculap, Tuttlingen, Germany) of an adequate length was then introduced bridging the defect zone by at least 4-6 cm and cerclage closure of the osteotomy site was performed. The distal interlocking was performed depending upon the grade of proximal femoral deficiency and quality of distal fixation. No interlocking was performed in 5 cases. Interlocking was optional in case of Paprosky Type II and IIIA defects and mandatory in case of Type IIIB and IV defects. Two interlocking bolts were used in 43 cases, whereas only the

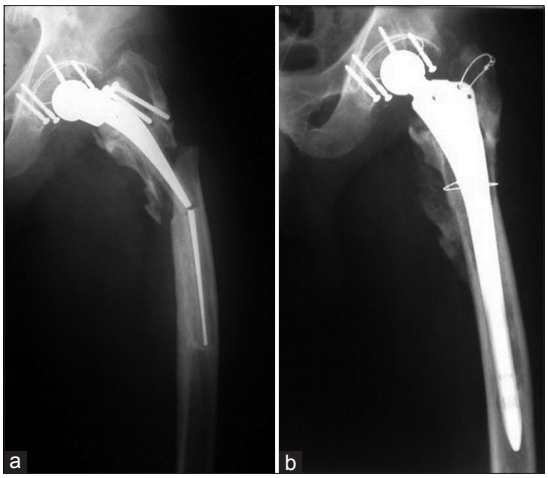

Figure 1: Preoperative X-ray (anteroposterior view) of left hip (a) showing grade III b Paprosky defect managed with isolated femoral revision 7 years followup X-ray (b) shows no subsidence.

Figure 2: Preoperative anteroposterior view of right hip (a) shows grade IV Paprosky defect managed with isolated femoral revision immediate postoperative (b) and 9 years followup (c) X-Rays after bolt removal showing good proximal bone healing and no subsidence

most distal interlocking slot was used in 18 cases. Image guidance or the jig provided by the manufacturer was used for interlocking and one or two bolts were used according to the preference of the operating surgeon. Morselized allografts were packed around the implant at the time of introduction and slurry grafts (product of acetabular reaming) were used around the osteotomy. Interlocking bolts were removed at a mean of 14 months (range 6-24 months) postoperatively.

The average hospitalization time of the patients was 16 days. The patients with a transfemoral osteotomy ($n = 25$) were allowed only nonweight bearing ambulation using a walker for the first 6 weeks followed by toe touch ambulation for a further 6 weeks. In cases where a cortical window was made ($n = 27$), toe touch ambulation with the help of a walker was started as soon as the patients were comfortable. An abduction brace was used for ambulation in the first 2 weeks following surgery in 41 cases. An abduction pillow was used when in bed during the same period.

Followups were at 6 weekly intervals for the first 6 months and then annually, with the latest followup between May and June 2012. Radiological and clinical evaluation including Harris hip score was performed at every visit.[6] The radiographs were evaluated for evidence of fixation and signs of instability according to the criteria of Engh *et al*. apart from remodeling and reconstruction of the proximal femoral bone stock.[7]

The criteria of Gross *et al*. were used to define a successful result in our series.[8] These criteria include a postoperative increase in the Harris hip score of more than 20 points, a radiologically stable implant, and no need for further femoral reconstructive surgery. Additionally, the classification of a successful result included signs of regeneration of the proximal femur and absence of stress shielding.

Results

Average followup was 9 years (range 8-14 years) with no re-revision being required at the time of final followup for any stem. There was an improvement in Harris hip scores from a mean value of 41 to 74 points.

The radiological evaluation did not reveal proximal stress shielding in any case. However, there was evidence of distal cortical hypertrophy in cases where the interlocking bolts were not removed. None of the cases showed any evidence of extensive reactive lines or a pedestal sign. Spot welds were seen adjacent to the proximal plasma sprayed surface of the stems in 43 cases. Average subsidence of approximately 10 mm was seen in stems without interlocking (range 0-12 mm). There was one subsidence in cases where interlocking was performed after secondary removal of the bolts. Proximal bone remodeling and restoration was visible in all the cases.

Complications

Three cases developed recurrent dislocation, which was managed by cup revision in two and use of 28 mm liner instead of 22 mm and +6 mm head in the third case. One patient developed about 1 cm subsidence after removal of the interlocking bolts at 2 years. This patient had a revision for periprosthetic fracture about an isoelastic stem, proximally tibial allograft from TKR bone cut was used to reconstruct a proximal femoral deficiency. The fracture had healed successfully. However, the hip remained stable and the patient continued to walk with an abductor lurch. None of the cases developed deep infection, periprosthetic fracture, or aseptic loosening.

Discussion

The poor proximal bone stock in revision hip surgery requires implants that give fixation distal to the bony defects.[2] Implants which are extensively porous coated lead to further stress shielding of the proximal femur due to the nonphysiological load transfer.[9,10]

Cemented fixation is not ideal in such cases as there is not enough cancellous bone stock in the proximal femur to secure an adequate micro-interlock of the cement to the bone.[11] The stems, which are proximally coated, lack initial stability and fail by subsidence.[12]

The BiCONTACT system (B.Braun-Aesculap, Tuttlingen, Germany) using the "reversed fixation" principle provides primary stability with the option to transfer load delivery back to the proximal femur secondarily. The initial torsional and axial stability of this system favors healing and remodeling of the proximal femur. The removal of interlocking bolts contributes to physiological load transfer to the proximal metaphyseal area of the femur and prevents further loss of bone stock due to stress shielding.[3,13]

An ideal study would include a prospective randomized controlled trial to evaluate the efficacy of distal locking in revision THA. A retrospective study has inherent limitations and bias. However, it does provide useful information and directions for further research. Our study indicated excellent results with use of distal locked implants. None of the cases were revised and only one demonstrated loosening. Subsidence was noted when distal locking was not performed in cases with low-grade bone loss. This underlines the need for primary stability with distal locking in these implants. Routine removal of interlocking bolts was performed at two years to transfer

the load proximally. This correlates well with various authors who have presented their results with such prosthesis in the past.

Mahomed *et al*. reported that distal interlocking of a press fit femoral prosthesis increased the torsional and axial stability which led to improvement in biological fixation.[14] Kim *et al*. reported the results of 68 femoral revisions done with a cementless proximally porous-coated stem with distal interlocking screws (BiCONTACT: B.Braun-Aesculap, Tuttlingen, Germany). At final followup at a mean of 40 months, there was no subsidence or loosening in their series.[15] Volkmann *et al*. reported a calculated survival rate of 85.3% with an increase in the Harris hip scores from 42 to 75 points in their series of 109 cases with a mean followup of 5.25 years.[3] Eingartner *et al.* reported similar encouraging results.[13] Learmonth *et al*. have reported results of revision hip arthroplasty using the BiCONTACT system (B.Braun-Aesculap, Tuttlingen, Germany) in 22 cases with Vancouver type B2 periprosthetic fractures.[16] We had six cases with Vancouver type B3 fractures and three cases with Vancouver type B2 fracture in our series. We have experienced a successful result with these cases in our series without complications. Sotereanos *et al*.[17] have also demonstrated the effectiveness of distal locking with a 94% success rate in their series. However, a custom-built prosthesis was used in their series. Furthermore, the stems were extensively porous coated and therefore lack the advantage of the BiCONTACT system in preventing further proximal bone loss. The BiCONTACT system, using the "reversed fixation" principle, provides primary stability with the option to transfer load delivery back to the proximal femur secondarily. This is a biological method of revision as claimed by Volkmann *et al*.[3,13] In our study, there was no stress shielding visible even in cases without removal of the interlocking bolts in spite of the cortical hypertrophy seen around the distal end of the prosthesis. The absence of subsidence after secondary interlock bolt removal is evidence of osseointegration leading to secondary stability.

To conclude, a distal locked system is a useful implant system while dealing with revision hip cases with high-grade proximal femoral defects. It provides adequate stability in reconstruction of proximal femoral bone loss. Further prospective studies will help to determine whether these implants are superior to the currently available implants used in revision hip surgery.

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